Reproduction in Organisms

Chapter 1

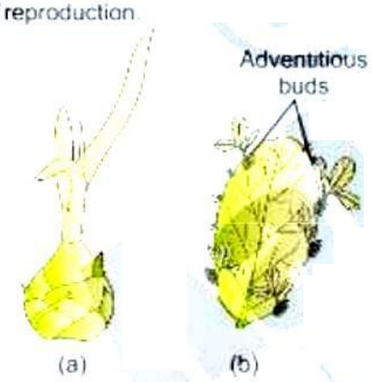
1 INTRODUCTION

- The period from birth to natural death of an organisms is called its life span. Life spans of organisms are not necessarily correlated with their sizes, the sizes of crows and parrots are not very different yet their life spans show a wide difference. Similarly, a mango tree has a much shorter life span as compared to a peepal tree. No organism is immortal except single celled organisms.
- Reproduction is defined as a biological process in which organism gives rise to young ones (offspring) similar to itself. Based on whether there is participation of one organism or two in the process of reproduction, it is of two types. When offspring is produced by a single parent with or without involvement of gamete formation, the reproduction is asexual. When two parents (opposite sex) participate in the reproductive process and also involve fusion of male and female gametes, it is called sexual reproduction.
- The organism's habitat, its internal physiology and several other factors are collectively responsible for how it reproduces.

2 ASEXUAL REPRODUCTION

- In this method, a single individual (parent) is capable of producing offspring (clones).
- The term clone is used to describe such morphologically and genetically similar individuals.
- Asexual reproduction is common among single celled organisms and in plants and animals with relatively simple organisations.
- In protists and monerans, cell division is itself a mode of reproduction.
- Organisms reproduce asexually by
  a. Binary fission : *Amoeba*, *Paramecium*
  b. Budding : Yeast
  c. Fragmentation : *Hydra*

  Asexual reproductive structures
  a. Zoospores : Fungi and Algae
  b. Conidia : *Penicillium*
  c. Buds : *Hydra*
  d. Gemmules : Sponge
  e. Bulbils : *Agave*



Vegetative propagules in angiosperms:
(a) Bulbil of *Agave*; (b) Leaf buds of *Bryophyllum*

- In plants, the term vegetative reproduction is frequently used for asexual reproduction. In plants, the units of vegetative propagation such as runner, rhizome, sucker, tuber, offset, bulb are all capable of giving rise to new offspring. These structures are called vegetative propagules.

- Water hyacinth also called terror of Bengal is one of the most invasive weeds found growing in standing water, propagating through offset.
  - It drains oxygen from the water, which leads to death of fishes.
  - This plant was introduced in India because of its beautiful flowers and shape of leaves. Since it can propagate vegetatively at a phenomenal rate and spread all over the water body in a short period of time, it is very difficult to get rid off them.

3 SEXUAL REPRODUCTION

- Sexual reproduction involves formation of male and female gametes, either by the same individual or by different individuals of the opposite sex. These gametes fuse to form the zygote which develops to form the new organism.
- It is an elaborate, complex and slow process as compared to asexual reproduction.
- Because of the fusion of male and female gametes, sexual reproduction results in offspring that are not identical to the parents or amongst themselves. When it comes to sexual mode of reproduction, organisms share a similar pattern, though they differ greatly in external morphology, internal structure and physiology.
- All organisms have to reach a certain stage of growth and maturity in their life, before they can reproduce sexually. That period of growth is called the juvenile phase. It is known as vegetative phase in plants. This phase is of variable duration in different organisms.
- Plants-the annual and biennial types, show clear cut vegetative, reproductive and senescent phases, but in the perennial species it is very difficult to clearly define these phases.
- A few plants exhibit unusual flowering phenomenon, such as bamboo species flower only once in their life time, generally after 50-100 years, produce large number of fruits and die.
- *Strobilanthus kunthiana* flowers once in 12 years, this plant flowered last during September October 2006.
- In both plants and animals, hormones are responsible for the transitions between the three phases. Interaction between hormones and certain environmental factors regulate the reproductive processes and the associated behavioural expressions of organisms.

- Buds (eyes) of potato tuber, rhizome of banana and ginger give rise to new plants. The site of origin of the new plantlets in the plants are invariably the nodes present in the modified stems of these plants.
- Adventitious buds arise from the notches present at margins of leaves of *Bryophyllum*.

4 EVENTS IN SEXUAL REPRODUCTION

- The events in sexual reproduction follow a regular sequence. These sequential events may be grouped into three distinct stages namely the pre-fertilisation, fertilisation and the post-fertilisation events.

5 PRE-FERTILISATION EVENTS

- These include all the events of sexual reproduction prior to the fusion of gametes. The two main pre-fertilisation events are gametogenesis and gamete transfer.

Gametogenesis

- Gametogenesis refers to the process of formation of the two types of gametes – male and female. In some algae the gametes are homogametes (isogametes). However, in a majority of sexually reproducing organism the gametes are heterogametes. In such organisms the male gamete is called antherozoid or sperm and the female gametes is called the egg or ovum.

Name of organism	Meiocyte (2n)	Gamete (n)
Human beings	46	23
Fruit fly	8	4
Ophioglossum (a fern)	1260	630
Apple	34	17
Rice	24	12
Maize	20	10
Potato	48	24
Butterfly	380	190
Onion	16	8

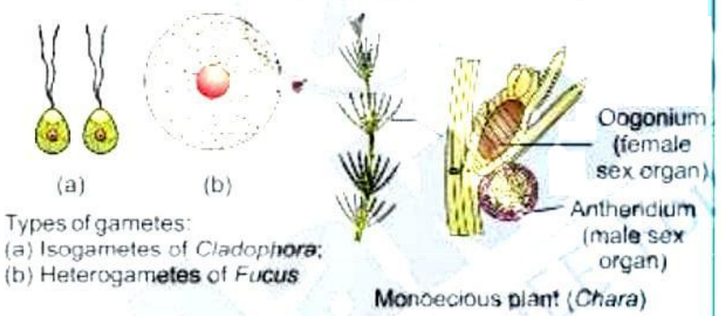
Chromosome numbers in meiocytes and gametes of some organisms.

Cell division during gamete formation :

- Gametes are haploid though the parent body may be haploid or diploid.
- A haploid parent produces gametes by mitotic division whereas a diploid parent produces gametes by meiosis in meiocytes (gamete mother cell). At the end of meiosis, only one set of chromosomes gets incorporated into each gamete.
- Monerans, fungi, algae and bryophytes possess haploid body.
- Pteridophytes, gymnosperms and angiosperms possess diploid body.

Sexuality in organisms

- Plants may have both male and female reproductive structures in the same plant (bisexual) or on different plants (unisexual). In several fungi and plants, terms such as homothallic and monoecious are used to denote the bisexual condition and heterothallic and dioecious are the terms used to describe unisexual condition.
- In flowering plants, the unisexual male flower is staminate, while the female is pistillate.
- Some examples of monoecious plants are cucurbits and coconut and of dioecious plants are papaya and date palm.



Types of gametes:
(a) Isogametes of *Cladophora*;
(b) Heterogametes of *Fucus*

Monoecious plant (*Chara*)

Gamete transfer

- In several simple plants like algae, bryophytes and pteridophytes, water is the medium through which gamete transfer takes place.
- A large number of the male gametes, however fail to reach the female gametes. To compensate this loss of male gametes during transport, the number of male gametes produced is several thousand times the number of female gametes produced.
- In seed plants, pollen grains are the carriers of the male gametes. A specialised event called pollination facilitates transfer of pollen grains to the stigma.
- Successful transfer and coming together of gametes is essential for the most critical event in sexual reproduction, the fertilisation.

6 FERTILISATION

- Fusion of gametes is called syngamy or fertilisation, which results in formation of a diploid zygote.
- It is the most vital event of sexual reproduction.

Where does syngamy occur?

- **External fertilisation :** (Requires great synchrony between sexes and release of large number of gametes) — Fertilisation outside the body of the organism. Eg. Majority of algae and fishes as well as amphibians.
- **Internal fertilisation :** (Number of sperms produced is very large though there is significant reduction in number of eggs) — Synagamy occurs inside the body of the organism. Eg. Higher animals and majority of plants.

7 POST FERTILISATION EVENTS

Events in sexual reproduction after the formation of zygote are called post-fertilisation events.

The zygote

- Formed in all sexually reproducing organisms.
- Development of the zygote depends on the type of life cycle the organism has and the environment it is exposed to.
- Zygote is the vital link that ensures continuity of species between organisms of one generation and the next.

Embryogenesis

- Embryogenesis refers to the process of development of embryo from the zygote. During embryogenesis, zygote undergoes cell division and cell differentiation.
- In flowering plants, the zygote develops in the embryo, ovule into seed, ovary into fruit which has a thick wall called pericarp that is protective in function. After dispersal, seeds germinate to produce new plants.

- A major disadvantage of external fertilisation is that the offsprings are extremely vulnerable to predators threatening their survival upto adult hood.

Sharpen Your Understanding

NCERT Based MCQs

1. Select the **odd** one w.r.t. life span [NCERT Pg. 3]

   (1) It is the period from birth to natural death of an organism

   (2) It should be necessarily correlated with the size of the organisms

   (3) Mango tree has a shorter life span as compared to a peepal tree

   (4) No individual is immortal, except single celled organisms

2. Asexual reproduction can not involve [NCERT Pg. 5]

   (1) Single parent

   (2) Gamete formation

   (3) Clone formation

   (4) Fusion of male and female gametes

3. A single cell divides into two halves and each rapidly grows into an adult in the process called [NCERT Pg. 6]

   (1) Binary fission

   (2) Budding

   (3) Fragmentation

   (4) Sporulation

4. Zoospores are [NCERT Pg. 7]

   (1) Motile (2) Non motile

   (3) Microscopic (4) Both (1) and (3)

5. Select the **incorrect** one about 'water hyacinth'. [NCERT Pg. 8]

   (1) Most invasive weed

   (2) Also called terror of Bengal

   (3) Drains oxygen from water, leads to death of the fishes

   (4) Found in running water

6. Eyes of the potato tuber are [NCERT Pg. 8]

   (1) Leaves (2) Roots

   (3) Buds (4) Internodes

7. *Bryophyllum* reproduce vegetatively by [NCERT Pg. 8]

   (1) Root **(2) Stem**

   (3) Leaf buds (4) **Flower**

8. Which of the following is a Pre-fertilisation event? [NCERT Pg. 10]

   (1) Fusion of gametes

   (2) Gamete transfer

   (3) Formation of zygote

   (4) Embryogenesis

9. Homogametes are [NCERT Pg. 11]

   (1) Similar in appearance

   (2) Morphologically distinct types

   (3) Also called isogametes

   (4) Both (1) and (3)

10. If in the meiocyte of apple there are 34 chromosomes then how many chromsomes will be seen in gamete? [NCERT Pg. 13]

    (1) 16 (2) 17

    (3) 8 (4) 21

11. Pollination is [NCERT Pg. 14]

    (1) Germination of pollen grains

    (2) Movement of pollen grains

    (3) Transfer of pollen grains to stigma

    (4) Fusion of gametes

12. Organisms showing internal fertilization [NCERT Pg. 15]

    (1) Show fertilization in external medium

    (2) Produce egg inside the female body

    (3) Always have motile gametes

    (4) Must show synchrony between release of gametes

13. Zygote is always [NCERT Pg. 15]

    (1) Diploid (2) Haploid

    (3) Triploid (4) Pentaploid

14. After fertilization the zygote usually develops into [NCERT Pg. 16]

    (1) Seed

    (2) Embryo

    (3) Ovule

    (4) Pericarp

15. In which of the given plant group meiosis occur during gamete formation? [NCERT Pg. 11]

(1) Bryophytes (2) Fungi

(3) Most of the algae (4) Angiosperm

16. Monoecious plants are [NCERT Pg. 11]

(1) Cucurbits and papaya

(2) Date palm and papaya

(3) Coconuts and date palm

(4) Cucurbits and coconuts

17. *Hydra* reproduces by [NCERT Pg. 7]

(1) conidia (2) Zoospores

(3) Gemmules (4) Buds

18. Select the odd one w.r.t sexual reproduction [NCERT Pg. 8-9]

(1) Involves fusion of gametes

(2) It is an elaborate, complex and slow process

(3) Leads to variations in the offspring

(4) Offsprings are identical to parents

19. Gametes in all heterothallic fungi are of [NCERT Pg. 11]

(1) Three types (2) Two types

(3) Four types (4) Single type

20. In *Chara*, the female sex organ is called [NCERT Pg. 12]

(1) Antheridium

(2) Oogonium

(3) Stamen

(4) Anther

Thinking in Context

1. In _____ and _____, cell division is itself a mode of reproduction [NCERT Pg. 5]
2. *Strobilanthus kunthiana* flowers once in _____ years [NCERT Pg. 9]
3. When both male and female flowers are present on the same plant body, this is termed as _____. [NCERT Pg. 11]
4. _____ is the vital link that ensures continuity of species between organisms of one generation and the next [NCERT Pg. 15]
5. _____ is the process of development of embryo from the zygote. [NCERT Pg. 15]
6. Majority of plants show _____ fertilization [NCERT Pg. 15]
7. The _____ develops into the fruit which develops a thick wall called _____ [NCERT Pg. 16]
8. The most vital event of sexual reproduction is perhaps _____. [NCERT Pg. 14]
9. In diploid organisms, specialized cells called _____ undergo meiosis [NCERT Pg. 13]
10. In flowering plants, the unisexual male flower is called _____. [NCERT Pg. 11]
11. Several organisms belonging to monera, fungi, algae and bryophytes have _____ plant body. [NCERT Pg. 11]
12. During embryogenesis, zygote undergoes _____ and _____. [NCERT Pg. 15]
13. _____ refers to process of formation of gametes [NCERT Pg. 10]
14. Term monoecious is used to denote the _____ condition [NCERT Pg. 11]
15. At the end of meiosis, only _____ of chromosomes gets incorporated into each gamete [NCERT Pg. 13]
16. In a majority of organisms, the male gamete is _____ and the female gamete is _____. [NCERT Pg. 13]
17. In seed plants, the non motile male gametes are carried to female gamete by _____. [NCERT Pg. 15]
18. In organisms with _____ zygote divides by meiosis to form haploid spores that grow into haploid individuals. [NCERT Pg. 15]
19. Transfer of pollen grains to stigma is relatively easy in _____ than in papaya [NCERT Pg. 14]
20. A haploid parent produces gametes by _____. [NCERT Pg. 11]

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